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PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of

Kenji INAGE et al.

Group Art Unit: 2652

Application No.: 09/911,408

Examiner: Brian E. Miller

Filed: July 25, 2001

Docket No.: 110199

For: MAGNETORESISTIVE DEVICE AND METHOD OF MANUFACTURING SAME AND THIN-FILM MAGNETIC HEAD AND METHOD OF MANUFACTURING SAME

REQUEST FOR RECONSIDERATION

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In reply to the February 25, 2004 Office Action, reconsideration is respectfully requested in light of the following remarks. Claims 5, 10, 15 and 20-28 are pending.

I. Request for Acknowledgement of Receipt of Priority Documents

The Office Action has not acknowledged the priority documents of Japanese Patent No. 2000-237365, filed August 4, 2000 and Japanese Patent No. 2001-213544 filed July 13, 2001. These priority documents were submitted on November 5, 2001. Accordingly, please acknowledge receipt of the priority documents and indicate that the requirements of 35 U.S.C. §119 has been satisfied.

II. The Claims Define Patentable Subject Matter

The Office Action rejects claims 5, 10, 15 and 20-28 under 35 U.S.C. §103(a) over Nakamoto (U.S. Patent No. 5,936,810) in view of Gill (U.S. Patent No. 6,538,859). The rejection is respectfully traversed.

In particular, the Office Action on page 3 admits that Nakamoto does not expressly disclose or suggest a magnetoresistive device including: (A) a total length of regions of the two electrode layers that are laid over the one of the surfaces of the magnetoresistive element is smaller than 0.3 μm; and (B) a space between the two electrode layers is equal to or smaller than approximately 0.6 μm, as recited in independent claim 5, and similarly recited in independent claims 10, 15 and 20. However, the Office Action asserts that absent any unobvious or unexpected results, the above feature would have resulted through the course of routine engineering, optimization, and experimentation. Applicants respectfully disagree.

The claims, inter alia, recite a space between the two electrode layers is equal to or smaller than approximately 0.6 μm. The specification clearly discloses that unexpected results, that is, the Barkhausen noise is remarkably reduced in the claimed dimension. Below is an excerpt from the specification that describes this unexpected results.

> As shown in [Table 2] and FIG. 16, there is no great difference in the frequency of occurrence of Barkhausen noise among the four types in the range in which the electrode space MRT1 is greater than 0.6 μm. However, in the range in which the electrode space MRT1 is equal to or smaller than 0.6 μm, greater differences in the frequency of occurrence of Barkhausen noise are created among the four types, as the electrode space MRT1 decreases. In the range in which the electrode space MRT1 is equal to or smaller than 0.6μm, the frequency of occurrence of type D is the highest, and the frequency of occurrence decreases in the order of type A, type C and type B. That is, in this range, the frequency of occurrence of Barkhausen noise of type B that is the device of the embodiment of the invention is lower than that of each of types A, C and D. In this range the frequency of occurrence of Barkhausen noise of type B decreases as the electrode space MRT1 decreases. In contrast, the frequency of occurrence of each of types A, C and D increases as the electrode space MRT1 decreases.
>
> The reason that the frequency of occurrence of Barkhausen noise of each of types C and D increases as the electrode space MRT1 decreases is that the proportion of the widths of the domains 5C with respect to the entire width of the MR element 5 increases as the electrode space MRT1 decreases, and the effect of the domains 5C increases. The reason that the frequency of occurrence of Barkhausen noise of type A increases as the electrode space MRT1 decreases is that the proportion of the widths of the dead regions with respect to the entire width of the MR element 5 increases

> as the electrode space MRT1 decreases, and the effect of the dead regions increases.
>
> The foregoing result of experiment shows that the magnetoresistive device of the embodiment of the invention **more greatly reduces Barkhausen noise**, compared to the devices having the other structures, such as types A, C and D. According to the experiment, **the device of the embodiment exhibits a greater effect of reducing Barkhausen noise when the electrode space MRT1 is 0.6μm or smaller**. See pages 31-32 of the application, emphasis added.

The above emphasized passages are contradictory to what is known to one skilled in the art as disclosed by Nakamoto. For example, Nakamoto at col. 2, line 64 -col. 3, line 2 discloses that "[W]hen the electrode spacing is simply reduced in the prior art hard bias system spin valve head, the output (sensitivity) per unit electrode spacing abruptly decreases. Particularly, when the electrode spacing is reduced to 2μm or less, the sensitivity of the head is reduced to 90% or less of its inherent sensitivity." Stated differently, prior to Nakamoto, one skilled in the art would not be motivated to reduce the electrode spacing beyond 2μm since the head sensitivity is reduced.

Nakamoto's device, on the other hand, through various experimentation (see, for example, FIGs. 4-7) shows that a high sensitivity is maintained even if the electrode spacing is reduced to 1.0μm (see generally, Nakamoto). However, importantly, Nakamoto at FIG. 5 shows experimentation results in which head sensitivity starts deteriorating when electrode spacing is less than 1.0μm.

Therefore, Nakamoto does not render obvious that a greater effect of reducing Barkhausen noise occurs when the electrode space MRT1 is 0.6μm or smaller. Accordingly, this is an unexpected result to what is taught in Nakamoto, and what is known to those skilled in the art.

Moreover, the claims recite, inter alia, a total length of regions of the two electrode layers that are laid over the one of the surfaces of the magnetoresistive element is smaller than 0.3 μm. Nakamoto, through various experimentation, shows that high sensitivity is maintained even if the electrode spacing is reduced to 0.5μm(or 1.0μm total length). However, Nakamoto strongly

discourages setting the overlap amount to be smaller than 0.25μm (or 0.5μm total length). According to Nakamoto at col. 9, line 65-col. 10,line 1, "It is seen from FIG. 7 that in order to maintain the head output to not lower than 90% of its inherent output, the overlap amount may be set to not smaller than 0.25μm." As shown in FIG. 7, Nakamoto concludes that any overlap smaller than 0.25μm results in rapid deterioration of the head's sensitivity. This is contradictory to what is recited in the claimed invention. The claims recite a total length of regions of the two electrode layers that are laid over the one of the surfaces of the magnetoresistive element is smaller than 0.3 μm. Therefore, Nakamoto does not render obvious the features of the claimed invention.

Gill does not compensate for the above-noted deficiency of Nakamoto. Gill discloses in Fig. 6, a spin valve (SV) sensor 600 having an antiferromagnetic layer 620 deposited over a third sublayer 612 to the thickness at which the desired exchanged properties are achieved. A laminated antiparallel (AP) pinned layer 622 is formed on the antiferromagnetic layer 620 in the central region 606. The AP pinned layer 622 comprises a first ferromagnetic layer FM1 624, a second ferromagnetic layer FM2 628, and an antiparallel coupling (APC) layer 626 disposed between the FM1 layer 624 and the FM2 layer 628.

Accordingly, independent claims 5, 10, 15 and 20 define patentable subject matter. Claims 21-28 depend from the respective independent claims, and therefore also define patentable subject matter. Accordingly, withdrawal of the rejection under 35 U.S.C. §103(a) is respectfully requested.

I. Conclusion

In view of the foregoing amendments and remarks, this application is in condition for allowance. Favorable reconsideration and prompt allowance of claims 5, 10, 15 and 20-28 are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number listed below.

Respectfully submitted,

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Date: May 25, 2004

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